PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 12456790	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. **PCT/AU2004/000786**	International filing date *(day/month/year)* 15 June 2004	Priority date *(day/month/year)* 19 June 2003
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] B01F 5/02		
Applicant COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of 7 sheets, as follows:
      - [X] sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      - [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:

[X]	Box No. I	Basis of the report
[ ]	Box No. II	Priority
[ ]	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
[ ]	Box No. IV	Lack of unity of invention
[X]	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
[ ]	Box No. VI	Certain documents cited
[ ]	Box No. VII	Certain defects in the international application
[ ]	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of the report
8 April 2005	2 June 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **JOHN DEUIS** Telephone No. (02) 6283 2146

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/AU2004/000786

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

   ☐ international search (under Rules 12.3 and 23.1 (b))

   ☐ publication of the international application (under Rule 12.4)

   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

   ☐ the international application as originally filed/furnished

   ☒ the description:

   pages as originally filed/furnished
   pages* **1-5** received by this Authority on **8 April 2005** with the letter of **8 April 2005**
   pages* received by this Authority on with the letter of

   ☒ the claims:

   pages as originally filed/furnished
   pages* as amended (together with any statement) under Article 19
   pages* **6-7** received by this Authority on **8 April 2005** with the letter of **8 April 2005**
   pages* received by this Authority on with the letter of

   ☒ the drawings:

   pages **1/3-3/3** as originally filed/furnished
   pages* received by this Authority on with the letter of
   pages* received by this Authority on with the letter of

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing (*specify*):
   ☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing (*specify*):
   ☐ any table(s) related to the sequence listing (*specify*):

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

Box No. V **Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-13	YES
	Claims		NO
Inventive step (IS)	Claims	1-13	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-13	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

None of the individual citations disclose all the essential features as claimed. Claims 1-13 are novel and involve an inventive step.

The invention is directed to a jet flow device comprising a secondary jet flow.

The closest art found was:
D1 US 5620250 A (CHILCOAT ET AL.) 15 April 1997
D2: US 2592904 A (JACKSON) 15 April 1952
D3: WO 2002/024317 A (TOFTE-JORG A/S) 28 March 2002
D4: US 4642138 A (KOYASE ET AL.) 10 February 1987
D5: FR 2797783 A (CORTIADE J M F L) 2 March 2001
D6: US 1156946 A (VANDERCOOK) 19 October 1915
D7: US 1073878 A (TRENT) 23 September 1913

PCT/AU2004/000786
Received 8 April 2005

JET DEVICE FOR MIXING FLUID

Field of the Invention

The present invention relates to a jet device particularly, but not exclusively, for mixing mono- or multi-phase fluid or a suspension in a large scale industrial tank or pool.

Background of the Invention

Large-scale industrial liquid and suspension tanks often experience poor flow circulation and sediment building up on a bottom of the tank. Poor mixing can cause material variation in fluid fed to downstream processing units.

Settling of particles can also lead to reduction in tank operating capacity and increased maintenance cost. For example, build-up of sludge sediment in crude oil tanks at oil refineries reduces effective tank working volume. Cleaning sludge sediment in these tanks is time consuming and labour intensive work. The tank down-time, direct cleaning and handling of sludge for disposal are significant costs to an oil refinery.

In the water industry, fine silt particles in a drinking water system build up in water storage tanks over time. Poor mixing in the tank leads to waste of chlorine dosed into the tanks. This leads to poor water quality for customers, and increased operating cost in tank cleaning and chlorine consumption.

Summary of the Invention

In accordance with the invention, there is provided a jet device with an outlet having a nozzle arranged to rotate as fluid exits the device, the nozzle being adapted to feed fluid into a tank and cause mixing of the contents of the tank as a result of fluid flow from the rotating nozzle, including: a control assembly for controlling rotation of the nozzle, wherein the control assembly includes an hydraulic motor operatively coupled to the nozzle and arranged to be driven by a secondary jet flow.

Preferably, the hydraulic motor includes a turbine arranged to be driven by a secondary jet flow. The hydraulic motor may include a conduit for delivering the jet flow to the turbine.

In one example, the conduit is arranged to divert fluid flowing through the device onto the turbine. More preferably, the turbine is in the form of a paddle assembly.

Preferably, the nozzle is adapted to rotate under action of flow momentum, resulting from fluid flow through the device. The nozzle is preferably laterally offset relative to a main housing of the device.

With that configuration, the control assembly functions as a speed governor and includes a paddle assembly operatively coupled to rotate under action of the rotating nozzle.

In either case, the control assembly is preferably connected to a gear box which is in turn coupled to the output via a shaft extending substantially coaxially with respect to the output.

In another aspect, there is provided a jet device with an outlet having a nozzle arranged to rotate as fluid exits the device, the nozzle being adapted to feed fluid into a tank and cause mixing of the contents of the tank as a result of fluid flow from the rotating nozzle, including: a control assembly for controlling rotation of the nozzle, wherein the control assembly includes a paddle assembly connected to the output via a gear.

Preferably, the device is dimensioned to pass through a service hole in the tank.

In another aspect, there is provided a method of fitting a jet device, as described above, in a tank, including passing the device through a service hole in the tank.

Brief Description of the Drawings

The invention is described, by way of non-limiting example only, with reference to the drawings, in which:

Figure 1 is a partially-sectioned perspective view of a jet device;

Figure 2 is a plan view of the device; and

Figure 3 is a partially-sectioned perspective view of another jet device.

Detailed Description

Referring firstly to Figures 1 and 2, a rotating jet device 1 includes an inlet 2 coupled to a main housing 3 for fluid communication with an outlet 4. The outlet 4 is mounted in a bearing 5 for rotation relative to the main housing 3. The outlet 4 includes a nozzle 6 which is laterally offset relative to the main housing 3 and, in particular, arranged laterally with respect to a flow path, indicated by arrow 7, which passes from the inlet 2, through the housing 3, to the outlet 4. The change in flow momentum, of fluid exiting the nozzle 6 in an offset direction produces a torque which causes the nozzle 6 to rotate relative to the housing 3 in a counter-clockwise direction, when viewed in Figure 2.

The inlet 2 of the device may be connected to an end of a feed pipe (not shown) so that pressurised fluid from the feed pipe is jetted out of the nozzle 6 and into surrounding fluid in a tank, or the like, in a rotational manner.

Rapid rotation of the nozzle 6 may not be particularly beneficial for mixing purposes and a control assembly 15, which functions as a speed governor 8 is provided to dampen the rotational speed of the nozzle 6. The governor 8 includes a paddle assembly 9 which is coupled to the outlet 4 via a gearbox 10 and a drive shaft 11 which is connected, via webs 12, substantially coaxially with respect to the outlet 4. Rotation of the outlet 4 and nozzle 6 thereby causes rotation of the drive shaft 11 which translates into a higher speed rotation of the paddle assembly 9. The paddle assembly 9 will experience flow resistance when the device is submerged in a tank and that flow resistance will govern the speed of rotation of the nozzle 6, to improve mixing.

Since the jet device 1 expels fluid via the rotating nozzle, the effective mixing of the device 1 is substantially increased as compared to a stationary-type inlet nozzle. Further, the speed of rotation is automatically governed by the paddle assembly 9 so that only slow rotation of the nozzle 6 occurs, to help maximise mixing efficiency. Also, because the rotation of the nozzle 6, and thereby the governor 8, is effected via flow momentum, from fluid passing through the device 1, no electrical power is required to drive the device. Accordingly, the device 1 is safe for use in mixing flammable liquids such as, for example, crude oil.

As such, the device may be installed in crude oil tanks which may typically be 60 to 70m in diameter and 16m in height. However, the device also has application to water storage tanks or any other suitable chemical, food, beverage or industrial waste-treatment tanks or pools, to improve mixing and to keep particulate matter in suspension during use, to thereby remove the requirement for tank off-line cleaning and the need to handle sediment or sludge which may result from improper mixing within the tank.

Another jet device 20 is shown in Figure 3. The device 20 is generally similar to that shown in Figures 1 and 2, and like parts are denoted with like reference numerals. The control assembly 15 in this instance, however, operates to drive the outlet 4 and nozzle 6 and, for that purpose, functions as an hydraulic motor, in which the paddle assembly 8 forms a turbine driven by a secondary jet of fluid which is made incident on the paddle assembly via a conduit 21.

The conduit 21 is coupled into the device 20 adjacent the inlet 2 so as to divert fluid flowing through the device 20 onto the paddle assembly 8. A self-cleaning filter 22 is provided to prevent coarse particles entering the conduit 21. The conduit may instead be connected to an alternative source of fluid flow (not shown), for example, an external pump equipped with a variable speed motor controller or other means of varying the flow rate to the conduit 21, such as a throttling valve.

The ability to drive the outlet 4 from the control assembly 15 provides an advantage in allowing the nozzle to be rotated in circumstances where proper operation of the jet device 1 would otherwise be impeded such as where the nozzle 6 is buried in sediment that has settled from a suspended state within a tank, during a period of non-use of the device.

Since the outlet 4 is driven by the control assembly 15, the nozzle 6 need no longer be laterally offset relative to the main housing 3 and that may serve to simplify construction to some degree. The dimensions of the paddles may also be reduced, as compared to the arrangement shown in Figures 1 and 2 which may allow the device 20 to be more easily passed through a service hole in a tank, for installation. The reduced size of the paddles results from the principle function of the paddle assembly 8 being to drive the outlet 4 at a predetermined speed, as opposed to providing flow resistance, as is required in the device

1. The paddles may, however, still provide a limited speed governing function due to flow resistance encountered during rotation and nevertheless need to be of sufficient size to allow relatively high torque to be transferred to the nozzle 6 particularly in situations where the nozzle encounters drag due to settled solids.

As with the device of Figures 1 and 2, the device 20 also has the advantage of the nozzle 6 being driven by fluid flow instead of electrical motors or the like, and that provides for greater safety in situations where the device is used with flammable liquids.

The device has been described by way of non-limiting example only and many modifications and variations may be made thereto without departing from the spirit and scope of the invention as described.

Claims:

1. A jet device with an outlet having a nozzle arranged to rotate as fluid exits the device, the nozzle being adapted to feed fluid into a tank and cause mixing of the contents of the tank as a result of fluid flow from the rotating nozzle, including:

a control assembly for controlling rotation of the nozzle, wherein

the control assembly includes an hydraulic motor operatively coupled to the nozzle and arranged to be driven by a secondary jet flow.

2. A jet device as claimed in claim 1, wherein the hydraulic motor includes a paddle assembly which is driven by the secondary jet flow.

3. A jet device as claimed in claim 2, wherein the control assembly includes a conduit for delivering the jet flow to the paddle assembly.

4. A jet device as claimed in claim 3, wherein the conduit is arranged to divert fluid flowing through the device onto the paddle assembly.

5. A jet device as claimed in claim 1, wherein the control assembly functions as a speed governor.

6. A jet device as claimed in any one of claims 1 to 5, wherein the paddle assembly is connected to a gear box which is in turn coupled to the output.

7. A jet device with an outlet having a nozzle arranged to rotate as fluid exits the device, the nozzle being adapted to feed fluid into a tank and cause mixing of the contents of the tank as a result of fluid flow from the rotating nozzle, including:

a control assembly for controlling rotation of the nozzle, wherein

the control assembly includes a paddle assembly connected to the output via a gear.

8. A jet device as claimed in claim 6 or 7, wherein the gear is coupled to the output via a shaft extending substantially coaxially with respect to the output.

9. A jet device as claimed in any one of claims 6 to 8, wherein the gear allows the speed of rotation of the nozzle to be determined based on flow resistance experienced by the paddle assembly.

10. A jet device as claimed in any one of claims 1 to 8, wherein the nozzle is adapted to rotate under action of flow momentum, resulting from fluid flow through the device.

11. A jet device as claimed in claim 10, wherein the nozzle is laterally offset relative to a main housing of the device.

12. A jet device as claimed in any one of claims 1 to 10, wherein the device is dimensioned to pass through a service hole in the tank.

13. A method of fitting a jet device, as claimed in any one of claims 1 to 11, in a tank, including passing the device through a service hole in the tank.